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I-CReST 2025:023-006 – Performance of Azulene and Azulene-PEG Saturable Absorber in Mode-Locked Thulium-Holmium Doped Fiber Lasers

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ABSTRACT

This study investigates the performance of azulene and azulene-PEG as saturable absorbers (SAs) to induce mode-locked pulses in thulium-holmium-doped fiber lasers (THDFLs). The incorporation of polyethylene glycol (PEG) with azulene significantly enhances stability and optical performance. Key findings include improved linear absorption by 256 %. The nonlinear optical properties such as modulation depth, and saturation intensity of azulene-PEG are higher compared to azulene. Stability tests showed that azulene-PEG maintained mode-locked operation for up to 2 days, compared to 5 hours for azulene. The laser efficiency of azulene-PEG was higher at 3.38% compared to 2.53% for azulene. These results indicate that azulene-PEG is a promising new class of saturable absorbers for ultrafast photonic applications, offering advantages in stability and performance over pristine azulene. This study contributes to the development of organic-based saturable absorbers for next-generation ultrafast laser systems.

Keywords: Azulene; azulene-PEG; saturable absorbers; polyethylene glycol; thulium-holmium doped fiber lasers